the following excesses: Florida Peninsula, 0.20; west Gulf, 0.50; North Dakota, 0.60; southern Slope (Abilene), 0.50; southern Plateau, 0.20; middle Plateau, 1.00; north Pacific, 3.50; middle Pacific, 2.50; southern Pacific, 0.40. The deficits are as follows: New England, 2.40; middle Atlantic, 1.90; south Atlantic, 1.10; east Gulf, 1.70; Ohio Valley and Tennessee, 2.60; lower Lake, 0.80; upper Lake, 0.50; upper Mississippi, 0.80; Missouri Valley, 0.50; northern Slope, 0.10; middle Slope, 0.50; northern Plateau, 0.20.

Details as to *excessive precipitation* are given in Tables XII and XIII.

The hourly distribution of precipitation is not now tabulated.

The *total monthly snowfall* at each station is given in Table II. Its geographical distribution is shown on Chart No. VI. The limit of freezing temperatures and possible snow is shown on the same chart by the isotherm of minimum 32°. The southern limit of frost in exposed localities is approximately shown by the isotherm of minimum 40°, within the thermometer shelter.

The depth of snow on the ground at the close of the month is shown on Chart VII.

HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 21, 22, 23. Arizona, 28, 29. Arkansas, 13. California, 17, 19, 20, 28, 29, 30. Florida, 22. Georgia, 21, 23. Louisiana, 21, 22, 25. Nevada, 21, 28. New Mexico, 29. North Carolina, 13. South Carolina, 23, 24. Tennessee, 23. Texas, 25, 30. Utah, 21.

SLEET.

The following are the dates on which sleet fell in the respective States:

Arkansas, 15, 23, 25. Colorado, 16, 22. Connecticut, 12, 24. Delaware, 31. Georgia, 7, 16, 23. Idaho, 1, 8, 15, 16, 17, 20 to 23, 29. Illinois, 10, 11, 16, 19, 21 to 24. Indiana, 19, 22, 23, 24. Iowa, 15, 17, 18, 19, 22, 23, 30, 31. Kansas, 14, 15, 16, 18, 30, 31. Kentucky, 10, 11, 16, 27. Louisiana, 6, 21. Maine, 3, 24, 25. Maryland, 9, 10, 19, 22, 23, 24. Massachusetts, 12, 22 to 25. Michigan, 9, 18, 22 to 25, 31. Minnesota, 6, 9, 10, 11, 15, 17, 19, 21, 23, 27 to 31. Mississippi, 15, 24, 25. Missouri, 15, 19, 20, 22 to 25. Montana, 10, 21. Nebraska, 14 to 19, 21, 22, 24, 29, 30, 31. Nevada, 13, 17, 21, 23, 25, 28. New Hampshire, 24, 25. New Jersey, 3, 7, 9, 24. New Mexico, 1, 26, 27. New York, 3, 18, 19, 23 to 26, 29, 30, 31. North Carolina, 7, 15, 16. North Dakota, 9, 11, 21, 30. Ohio, 3, 9, 14, 18, 19, 22, 23, 24. Oregon, 1, 16, 17, 18, 23. Pennsylvania, 3, 19, 22 to 26, 31. South Carolina, 15, 16. South Dakota, 15, 16, 21 to 24, 28 to 31. Tennessee, 7, 13, 23, 24. Texas, 28, 29, 30. Utah, 29. Virginia, 7, 8, 23. Washington, 1, 4, 8, 13 to 18, 23, 24, 25, 27. West Virginia, 3, 4, 5, 9, 21, 22, 23. Wisconsin, 10, 18, 20, 22, 23, 24.

WIND.

The *prevailing winds* for January, 1896, viz, those that were recorded most frequently, are shown in Table I for the regular Weather Bureau stations.

The *resultant winds*, as deduced from the personal observations made at 8 a. m. and 8 p. m., are given in Table IX. These latter resultants are also shown graphically on Chart IV, where the small figure attached to each arrow shows the number of hours that this resultant prevailed, on the assumption that each of the morning and evening observations represents one hour's duration of a uniform wind of average velocity. These figures indicate the relative extent to which winds from different directions counterbalanced each other.

The *diurnal variation* in the velocity of the wind is shown in Table VII, which gives the total movement for each hour of seventy-fifth meridian time, as deduced from self-registering anemometers at about 136 stations.

HIGH WINDS.

Maximum wind velocities of 50 miles or more per hour were reported at regular stations of the Weather Bureau as follows (maximum velocities are averages for five minutes; extreme velocities are gusts of shorter duration, and are not given in this table):

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
		Miles				*Miles*	
Block Island, R. I	10	54	ne.	Fort Canby, Wash	26	72	s.
Do	24	66	e.	Do	27	55	sw.
Cheyenne, Wyo	1	56	w.	Do	31	66	se
Denver, Colo	1	66	sw.	Landen, Wyo	1	50	w.
Do	2	54	nw.	Moorhead, Minn	21	53	se.
Eastport, Me	25	50	ne.	Tatoosh Island, Wash	5	53	s.
Fort Canby, Wash	5	72	s.	Do	6	54	se.
Do	6	60	se.	Do	7	60	se.
Do	7	70	s.	Do	16	59	e.
Do	8	61	s.	Do	17	52	e.
Do	16	59	se.	Do	25	52	s.
Do	19	60	s.	Do	26	50	s.
Do	20	66	s.	Winnemucca, Nev	18	52	sw.
Do	24	54	e.	Do	21	54	sw.
Do	25	73	s.	Woods Hole, Mass	4	53	nw.

SUNSHINE AND CLOUDINESS.

The quantity of sunshine, and therefore of heat, received by the atmosphere as a whole is very nearly constant from year to year, but the proportion received by the surface of the earth depends upon the absorption by the atmosphere, and varies largely with the distribution of cloudiness. The sunshine is now recorded automatically at 16 regular stations of the Weather Bureau by its photographic, and at 21 by its thermal effects. At one station records are kept by both methods. The photographic record sheets show the apparent solar time, but the thermometric sheets show seventy-fifth meridian time; for convenience the results are all given in Table XI for each hour of local mean time.

Photographic and thermometric registers give the duration of that intensity of sunshine which suffices to make a record, and, therefore, they generally fail to record for a short time after sunrise and before sunset, because, even in a cloudless sky, the solar rays are then too feeble to affect the self-registers. If, therefore, such records are to be used for determining the amount of cloudiness, they must be supplemented by special observations of the sky near the sun at these times. The duration of clear sky thus specially determined constitutes the so-called twilight correction (more properly a low-sun correction), and when this has been applied, as has been done in preparing Table XI, there results a complete record of clear sky from sunrise to sunset in the neighborhood of the sun. The twilight correction is not needed when the self-registers are used for ascertaining the duration of a special intensity of sunshine, but is necessary when the duration of cloudiness is alone desired, as is usually the case.

The cloudiness is determined by numerous personal observations at all stations during the daytime, and is given in the column of "average cloudiness" in Table I; its complement, or percentage of clear sky, is given in the last column of Table XI.

COMPARISON OF DURATIONS AND AREAS.

The sunshine registers give the *duration* of effective sunshine whence the duration relative to that of possible sunshine is derived; the observer's personal estimates give the percentage of *area* of clear sky. These numbers have been brought together, side by side, in the following table, from which it appears that, in general, the instrumental record of percentages of duration of sunshine is almost always larger than the observers' personal estimate of percentages of area of clear

sky; the average excess for January, 1896, is 4.4 per cent for photographic records, and 4.5 per cent for thermometric records. The details are shown in the following table in which the stations are arranged according to the greatest possible duration of sunshine, and not according to the *observed* duration as heretofore.

Difference between instrumental and personal observations of sunshine.

Photographic stations.	Possible duration.	Instrumental.	Personal.	Difference.	Thermometric stations.	Possible duration.	Instrumental.	Personal.	Difference.
	H'rs.	%	%	%		*H'rs.*	%	%	%
Galveston, Tex	326.8	45	44	1	New Orleans, La	324.6	42	41	1
Savannah, Ga	320.5	51	39	12	Vicksburg, Miss	320.5	34	32	2
San Diego, Cal	318.5	62	56	6	Atlanta, Ga	316.2	48	44	4
Santa Fe, N. Mex	311.8	77	63	14	Wilmington, N. C	316.2	53	52	1
Dodge City, Kans	306.5	55	47	8	Little Rock, Ark	314.7	40	35	5
Kansas City, Mo	303.7	34	37	— 3	Louisville, Ky	306.5	31	24	7
Washington, D.C	303.8	46	46	0	San Francisco, Cal	306.5	37	35	2
Eureka, Cal	298.4	25	26	— 1	Baltimore, Md	303.8	40	37	3
Salt Lake City, Utah	298.4	40	25	15	Cincinnati, Ohio	303.8	34	34	0
Cleveland, Ohio	295.5	20	23	— 3	St. Louis, Mo	303.8	48	41	7
Eastport, Me	286.8	54	43	11	Columbus, Ohio	301.1	25	20	5
Portland, Oreg. *	283.1	22	31	— 9	Philadelphia, Pa	301.1	57	45	12
Bismarck, N. Dak	279.8	30	35	— 5	New York, N. Y	298.3	48	45	3
Helena, Mont	279.8	41	44	— 3	Boston, Mass	295.5	52	48	4
Phœnix, Ariz	318.8	77	72	5	Chicago, Ill	295.5	35	30	5
Denver, Colo	301.1	80	57	23	Des Moines, Iowa	295.5	49	38	11
					Detroit, Mich	295.5	34	27	7
					Buffalo, N. Y	292.7	21	13	8
					Rochester, N. Y	292.7	49	26	23
					Portland, Me	289.7	62	45	17
					Portland, Oreg. *	283.1	26	31	— 5

* Records kept by both methods.

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table X, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

The dates on which reports of thunderstorms for the whole country were most numerous were: 21st, 33; 22d, 35d; 23d, 45; 31st, 27.

Thunderstorm reports were most numerous in Texas, 44; Florida, 33; California, 30; Louisiana, 28; Alabama, 19; Georgia, 16; Mississippi, 15.

Thunderstorms were most frequent in: Texas, 11 days; California, 8; Louisiana, 7; Florida and Mississippi, 5.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, from the 1st to the 4th, and also the 25th to the 31st, inclusive. On the remaining twenty days of this month 102 reports were received, or an average of about 5 per day. The dates on which the number of reports especially exceeded this average were: 3d, 71; 4th, 23; 5th, 21.

Auroras were reported by a large percentage of observers in: Maine, 126; New Hampshire, 77; North Dakota, 55; Minnesota, 27; Wisconsin, 26; New York, 20.

Auroras were reported most frequently in: North Dakota, 11 days; Montana, 10; Minnesota and Wisconsin, 9; Maine, New Hampshire, and New York, 8.

CANADIAN REPORTS.

No thunderstorms were reported.

Auroras were reported as follows: 2d, Charlottetown, Winnipeg; 3d, Quebec, Montreal, Rockliffe, Toronto, White River, Minnedosa, Prince Albert; 4th, Rockliffe, Toronto, White River, Port Arthur, Winnipeg, Prince Albert; 5th, St. Andrews, Toronto, White River; 6th, Father Point, Quebec, Minnedosa; 8th, Minnedosa, Medicine Hat; 9th, Montreal; 10th, Medicine Hat; 11th, Battleford; 13th, Minnedosa; 14th, Father Point, Minnedosa, Medicine Hat, Prince Albert; 15th, Father Point, Port Arthur; 16th, Port Arthur, Minnedosa, Edmonton; 17th, St. Andrews, Minnedosa; 18th, Father Point, Minnedosa, Battleford; 19th, Quebec, Minnedosa, Edmonton; 20th, Minnedosa; 21st, Father Point, Medicine Hat; 26th, Prince Albert; 29th, Medicine Hat; 31st, Yarmouth.

INLAND NAVIGATION.

The *extreme and average stages of water* in the rivers during the current month are given in Table VIII, from which it appears that the only river that rose above the danger line was the Sacramento, at Red Bluff, on the 29th.

ICE IN RIVERS AND HARBORS.

The charts of depth of snow on the ground and thickness of ice published weekly by the Weather Bureau show that by Monday, January 6, much ice had formed on the Great Lakes, the upper Mississippi and Missouri rivers; there was a general increase in thickness throughout the month and on Monday, January 27, the thickness in inches was about as follows:

Missouri River.—Miles City, 16; Williston, 25.5; Bismarck, 30; Pierre, 19; Yankton, 18.5; Sioux City, 15; Omaha, 10; Kansas City, 2.0.

Red River of the North.—Moorhead, 30.

Upper Mississippi.—St. Paul, 17; La Crosse, 15; Dubuque, 10.5; Davenport, 9; Keokuk and Hannibal, 0.

Hudson River.—Albany, 11.

Lake Superior.—Duluth, 21.5; Sault Ste. Marie, 7.

Lake Michigan.—Green Bay, 13; Milwaukee, 6; Chicago and Grand Haven, 0.

Lake Huron.—Alpena, 9.5; Port Huron, 6.0.

St. Clair River.—Detroit, 12.

Lake Erie.—Toledo, 4; Sandusky, 4; Cleveland, 4; Erie. 7.5; Buffalo, 4.

Lake Ontario.—Oswego and Rochester, 4.

METEOROLOGY AND MAGNETISM.

By Prof. FRANK H. BIGELOW.

It has been found expedient to make a further modification in the presentation of the meteorological and magnetic data, showing the approximate synchronisms in the two types of elements, beginning with January, 1896. This is in part due to the action of the vertical-force magnetometers at Washington and Toronto, which are both affected by magnetic waves from the neighboring trolley-line systems, and also, in part, to the improved operation of the new "magnet-watch," used as an integrator of work in the varying terrestrial magnetic field. The encroachment of trolleys into the neighborhood of our permanent magnetic observatories causes great injury in this branch of science. There seems to be no way to compensate this action without shutting off too much of the terrestrial field by excessive damping, and in that case the variations are greatly obscured. Fortunately the horizontal components, from the bifilar and the declinometer, are much less disturbed, inasmuch as the magnetic lines induced by the trolleys enter the earth along the normal, or very nearly so. The synchronism of the horizontal components at Washington and Toronto continues to be valuable; but in the vertical component the amplitudes derived from the data show very different sensitiveness, and the sequence of crests is also very irregular at times. This misfortune, falling upon our observatories, is to be deplored, but it can not be avoided, unless by removal of the instruments to locations far from all electric lines. In San Antonio, Tex., the same difficulty was encountered 3 miles from the trolley line, and it was found that such disturbances could be detected for a distance of 20 miles. Accordingly our computation has been modified by omitting ΔV, dz, s, and a, all of which depend upon the vertical force.